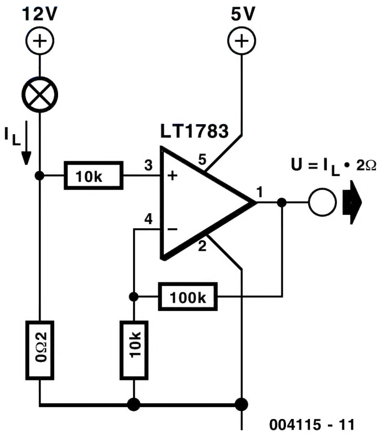
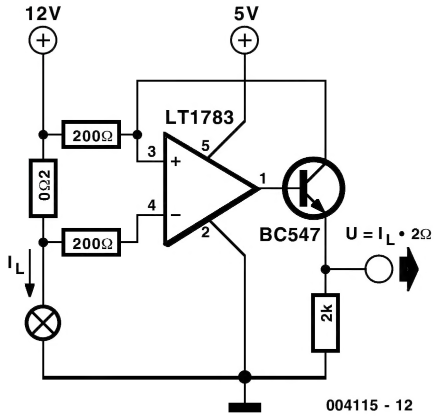
## 050

# Rail-to-Rail and Over-the-Top Opamp

a



b



**By G. Kleine**

The LT1783 rail to rail opamp is an exceedingly robust device. It has reverse battery protection up to 18 V, a common mode input voltage of up to 18 V and protection on the input allowing voltages of –10 V to +24 V relative to the negative supply pin 2 (V–, for most applications at earth potential). With these protective features and its rail-to-rail input and output capability and over-the-top i.e. with one or both its inputs above the positive rail, this device is ideal for current sense applications with the sense resistor either in the supply side or earth side of the current path

The first diagram (**a**) shows an earth side current sensor circuit with linear output voltage. The opamp has a fixed gain of 10 so that the output voltage will be linearly proportional to the current through the 0.2 Ω sense resistor.

The second diagram (**b**) shows a positive supply rail current sense circuit. The opamp together with the transistor form a current source. The opamp controls the current through the upper 200 Ω resistor so that it has the same voltage drop as across the 0.2 Ω sense resistor. This current will therefore be 1000 times smaller than the current $I_L$ through the lamp. This current through the 2 KΩ emitter resistor will produce a voltage at the output proportional to the load current. The relationship between the output voltage and load current is given in the diagram. You will notice that the lamp voltage in this application is +12 V while the supply voltage to the opamp is only +5 V.

The final diagram (**c**) shows a circuit that detects a blown lamp. The current sense resistor is again in the high side of the supply. When the lamp is switched off, both inputs to the opamp will be close to earth potential and when it is switched on they will both be close to the lamp supply voltage which, again, is much higher than the 3 V opamp supply. An output of +3 V from the opamp indicates that the lamp is burnt out. When the lamp is good and switched on, current through the 0.5 Ω sense resistor will produce 50 mV. When the lamp is switched off, a current through the 100 kΩ and 5 kΩ resistors will generate 15 mV across the inputs of the opamp. In both cases this will cause the output of the opamp to go low indicating that the lamp is OK.

When the lamp filament has blown the only path to earth will be through the internal 500 kΩ input resistors of the opamp. This time, the 5 kΩ resistor will generate a voltage between the inputs of the opamp of about 10 mV but of opposite polarity than before thereby producing a +3 V positive output from the opamp, indicating that the lamp is defective, the diode here will be reverse biased.

(004115)

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c